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TITLE: Motor vehicle dryer

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The dryer for a motor vehicle washing and drying system includes three downwardly-facing nozzles. The nozzles oscillate in a synchronized manner, with two side nozzles oscillating over a limited range only. A center nozzle, disposed between the two side nozzles, oscillates over a wider range to drive water on the upper surface of the vehicle towards the side nozzles. The side nozzles then drive the water along the contours of the vehicle surface down the sides of the vehicle using the Coanda effect. One of the side nozzles as well as the center nozzle is moved in an inward or outward direction depending upon the sensed width of the vehicle. The center nozzle is rotated in a forward or rearward direction as the vehicle moves underneath the dryer. Each nozzle contains a unique ovoid-shaped member disposed in the nozzle to accelerate and concentrate the output of the nozzles. The distance between the vehicle and the center nozzle is sensed by a triangulation sensor so that the output of the center nozzle may be adjusted as the height of the vehicle varies, and so that the center nozzle may be rotated in the forward or rearward direction.

Another key feature of the present invention is that the center nozzle may be rotated from a first position at which it is directed towards the front of the vehicle, to a second position at which it is directed

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towards the rear of the vehicle. This feature improves the drying of the vehicle since the output of the center nozzle is always leading the outputs of the two side nozzles, thereby tending to force the water toward the sides of the vehicles, whereupon the water is forced down the sides and off the vehicle by the side nozzles using the Coanda effect. The angular displacement of the nozzles during oscillation as well as the rate of oscillation are also limited to improve vehicular drying.

It is yet another feature and advantage of the present invention to use the Coanda effect to drive water down the side contoured surfaces of the vehicle and off the bottom of the vehicle.

FIG. 18 depicts water droplets being driven off a bottom vehicular surface using the Coanda effect according to the present invention.

FIGS. 2 and 3 are diagrammatic views which depict the means for oscillating nozzles 30, 34 and 36. The nozzles are oscillated in a synchronized manner, with center nozzle 30 oscillating in a much greater arc than side nozzles 30 and 34. Nozzle 36 preferably oscillates between 30.degree. to 40.degree., with 36.degree. being preferred. That is, nozzle 36 will oscillate in a symmetrical manner from the vertical axis, so that nozzle 36 oscillates a positive 18.degree. in one direction from the vertical axis toward the driver's side of the vehicle, and 18.degree. in the opposite direction from the vertical axis toward the passenger's side of the vehicle. The purpose of the oscillation of nozzle 36 is to drive the water towards the sides of the vehicle, so that the water may be driven down the sides of the vehicle by nozzles 30 and 34 using the Coanda effect.

As used herein, the term "Coanda effect" refers to the tendency of fluids to cling to curved surfaces while passing over the surfaces. In the present invention, the air from the nozzles is directed such that the air flow tends to cling to the surface of the vehicle all the way down the sides of the vehicle, thereby driving water droplets off the lower portions of the vehicle body.

The purpose of the oscillation of side nozzles 30 and 34 is primarily to cause the water to be driven along the contours of the sides of the vehicle, down the sides of the vehicle, and off the vehicle using the Coanda effect. In prior art dryer systems, the side nozzles were oscillated over a very wide arcuate range, so that the largest possible surface area would be covered. However, the inventors herein have discovered that the oscillation of the side nozzles should be limited to a much narrower arcuate range when compared to prior art devices, to prevent the side nozzles from driving water which is on top of the vehicle toward the center of the vehicle, as in prior art dryer systems. The inventors have discovered that superior drying is achieved when an oscillating center nozzle forces the water towards the sides of the vehicle, and the side nozzles oscillate only enough to allow the water to follow the contours of the sides of the vehicle and down the vehicle sides.

FIGS. 13 through 16 all relate to another feature of the present invention, namely that air output from a nozzle has both its velocity component and its direction component in the desired direction of travel increased as a result of the placement of an ovoid-shaped member of the central portion of the nozzle. As used herein, the term "ovoid-shaped" refers to a three dimensional shape

which is substantially the shape of a football, and is sometimes referred to as "egg-shaped", or an inflated three-dimensional oval shape. In FIG. 13, ovoid-shaped element 162 is disposed within each of the nozzles 30, 34 and 36 such that element 162 is centered within the nozzle near discharge end 164 of the nozzle. The shape of element 162 causes the airflow, indicated by arrows 166, to follow outer surface 162a of element 162 due to the Coanda effect. At the same time, those portions of the airflow closest to curved wall 168 of the nozzle, indicated by arrows 170, are also accelerated and channeled in a proper direction due to the constriction resulting from the placement of element 162 within the nozzle. This constriction is best shown in FIG. 15.

The channeling of the nozzle output air according to the present invention is achieved by element 162, the geometry of nozzle 161, as well as the flow of ambient air 172. This output air channeling causes the air output at discharge end 164 to have a higher velocity and a proportionally larger directional component in the downward direction when compared to prior art nozzles. These features of the present invention, together with the oscillation and rotation of the nozzles as discussed above to yield the Coanda effect, allow smaller-sized blower components to be used when compared to prior art devices while achieving superior results when compared to prior art devices. For example, a typical prior art system uses blowers having a rating of 40 hp, whereas the present invention only requires blowers having a rating of 30 hp to yield superior results.

FIGS. 17 and 18 are used to illustrate another important feature of the present invention, namely the Coanda effect. As referenced above,

the present invention synchronizes the oscillation of the nozzles, and selects the speed of oscillation, the positions of the side nozzles, the arcs through which the side nozzles oscillate, the forward and rearward rotation of the center nozzle, and the speed at which the dryer system changes position with respect to the motor vehicle (preferably at a rate of 15 cycles per second) to optimize the water removal from the motor vehicle by means of the Coanda effect. These components operate together to drive the water droplets down the sides of the vehicle, with the airflow tending to follow and cling to the contoured surface of the vehicular sides due to the Coanda effect.

In FIG. 18, water droplet 186 is driven downward along surface 178 by the airflow from the nozzles, represented by arrows 190. Airflow 190 tends to follow curved surface 178, in accordance with the Coanda effect. At the same time, droplets 192 are driven off of the vehicle by both nozzle airflow 190 and the ambient airflow, represented by arrows 194. By contrast, prior art dryers drove much of the water to the center and rear of the vehicle, and indeed often drove the water upward against gravity. As a result, significant amounts of water remained on the upper surface of the vehicle when prior art dryers were used. However, the present invention uses a different approach to drying, resulting in significantly improved water removal.